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PULSE-PERIODIC GYRORESONANCE PLASMA ACCELERATOR AS A SOURCE OF PULSED X-RAY RADIATION WITH A VARIABLE SPECTRUM IN RADIOLOGY *)

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One of the promising areas of modern biomedical investigations in the field of cancer control is the use of radiosensitizers based on high-Z metal nanoparticles and their compounds during radiation exposure [1,2]. The accumulation of nanoparticles in the affected cells makes it possible to significantly increase the absorbed dose and effectiveness of radiation therapy. At the same time, it needs to use radiation with relatively high quantum energies (more than 50-100 keV) to reduce the radiation load on patient.

First of all the interaction of X-ray and gamma radiation with nanostructured radio sensitizers is very important problem, as well as the problem of X-ray sources with the flexible spectral characteristics of radiation designing. This problem is usually solved using combined sources with multiple X-ray tubes and absorption filters, or sources with one or more radioisotopes.

It was shown that it is possible to obtain bremsstrahlung radiation with quantum energies above 100 keV by interaction of high-energy plasma bunches with gas and solid-state targets, obtained under gyromagnetic autoresonance regime (GA). Under such condition plasma bunches with average particle energies within 0.3–0.5 MeV range were obtained by charged particles interaction with the field of a standing microwave wave in a short [3] or long [4] magnetic trap. Generated bunches with ring structure are localized in minimum of a magnetic trap, where particle momentum is predominantly azimuthal. The average radius of ring structures of the order of 1-2 cm depends on the energy of the particles, as well as on the magnitude and spatial distribution of stationary and pulsed magnetic fields.

The energy spectrum of resulting bremsstrahlung and characteristic radiation depends on the target material and the energy of the plasma bunch particles. The results of numerical simulations and experiments showed that of high-energy radiation directed mainly across the magnetic field. Long trap GA realization is characterized by 20-30 ms confinement time of the bunch in the minimum field of the trap. In short trap GA variant, it is impossible to hold the bunch for a long time, however, the numerical modeling showed the possibility of bunch fall on a thin solid target (end plate of the cavity) by turn off one of the magnetic plugs. This makes it possible to achieve short pulses of high-intensity X-ray.

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